Cockpit Scan

and Loss of Situational Awareness

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It's mid-morning, and the five members of the TYCOM Fleet Naval Aviation Evaluation Board (FNAEB) are listening to a young lieutenant explain why he has been unable to land aboard a carrier at night. This board would recommend to the admiral whether this aviator should be allowed to continue flying or not—a weighty responsibility and one not taken lightly. The officer in question was a good stick, an aviator who could get onto the carrier deck with no problem during daytime ops. But his night landings were messy.

The lieutenant's problem had come to light in one of his squadron's periodic human-factors reviews. That human-factors board had recommended extra training and had given him a date to get up to quals-level performance. The date came and went, but the lieutenant still was having serious problems. He couldn't maintain a good scan, especially on final approach from in-the-middle to in-close at the ship. His scan, which should have been, "Meatball-AOA-lineup, meatball-AOA-lineup, meatball-lineup, meatball-lineup…," became "Deck, deck, deck…no ball!" Upon hearing this, all five members of the board shook their heads, almost in unison. They'd heard this all before. Most cockpit crews appearing before this board had said virtually the same thing: Their visual scans had broken down, severely impairing their ability to fly. Why?

Think back to when you were in that first VT or HT squadron learning. Were you taught to scan both inside and outside your cockpit? Did you receive any formal, basic, scan training? Some instructors told you when and where to look, but how did the instructors know if you were doing it right? Whether you were in the cockpit-procedures trainer or in your aircraft, instructors assumed if you were on heading, altitude and airspeed, then your scan must have been good.

Developing a good set of scan patterns isn't given high priority during training. This is disturbing because one of the most common forms of visual problems cited in mishaps is the breakdown in cockpit scan. This error has caused midairs and near-midairs, CFIT, inability to get onboard the ship, spatial disorientation, and loss of SA—according to data from the Naval Safety Center's Human Factors Analysis Classification System (HFACS), 30 percent of mishaps in the past decade.

What is scan? Aircrews regularly monitor their aircraft, paying attention to information from inside and outside the cockpit. Visual scan is a sequence of these monitoring tasks. Scan characteristics (where you look, how frequently and how long) are determined not only by the complexity and importance of the information provided by a particular target, but also by your level of expertise.

Studies of scan during instrument flight were conducted in the 1940s and '50s. They found several interesting things:

- Aircrews quickly create scan and fixation patterns for each maneuver.
- How long you fixate depends on your ability to observe and interpret the information from a target.
- The number of scan visits to a target (e.g., cockpit instrument, another aircraft in formation flight, and a landing zone) depends on how important you think the target is.

The path from training to expertise. Less experienced aircrews tend to scan ineffectively, making them more vulnerable to problems such as visual fixation, tunneling in on specific indicators, or the "electric-jet syndrome" (where normal scan is abandoned in favor of using data presented on newer digital avionics). Worse, many novice crews do not know where and when

to scan; they don't know enough about what produces and controls their aircraft's state. These individuals may scan only their primary instruments, neglecting the secondary indicators that actually give them information about the cross-coupled events associated with controlled flight.

What they need is a "mental model," a comprehensive understanding of a system and its dynamics. Mental models are refined with experience. Less experienced crews sometimes employ random, irregular scans, or, alternately, a more rigid scan that isn't sensitive to the changing needs for information from one moment to the next. Experienced pilots often feel uncomfortable when transitioning to a new aircraft because of a conflict between their mental model and their less-than-optimal scan in this new aircraft. They know they must cross-reference major attitude instruments (ADI, HUD, etc.) with basic instruments (turn needle and VSI), but their scan is too irregular or rigid to include these instruments.

More experienced crews are more flexible in their visual scans ("I can be thinking farther ahead of my aircraft and seeing more of the details happening around me"). They can react automatically to what they scanned, and if you asked them what triggered their reaction, they probably couldn't tell you. They develop better mental models, and they can scan all critical information sources ("I am no longer a 'HUD cripple"). They anticipate things more effectively.

Optimal vs. non-optimal scans. Aviators must balance the benefits gained from using information from a scanned target while minimizing cost or risks of leaving other stimuli unobserved ("I've gotta stare at my ADI until I figure out what it's telling me, so I'll ignore my airspeed for a while, and my oil pressure won't be changing much, and…").

Scan strategy used during one phase of a mission (e.g., searching for a "bad guy") will not be the same as that used during another mission phase (e.g., landing). As you become more effective at extracting data from a target, the task of perceiving and processing that information becomes more automatic. Crews using non-optimal scan may fixate or scan inappropriately, thereby missing important information.

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